DOCUMENT RESUME

ED 297 501 EC 210 352

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| TITLE | Commonly Asked Questions: Computers. Revised. |
| INSTITUTION | Wisconsin Univ., Madison. Trace Center. |
| PUB DATE | 87 |
| NOTE | 7p.; A product of the Trace Research and Development Center on Communication, Control, and Computer Access for Handicapped Individuals. |
| AVAILABLE FROM | Trace Center, University of Wisconsin-Madison, Waisman Center, 1500 Highland Ave., Madison, WI 53705-2280 (single copy free, $0.60 each additional copy). |
| PUB TYPE | Guides - Non-Classroom Use (055) |
| EDRS PRICE | MF01/PC01 Plus Postage. |
| DESCRIPTORS | *Assistive Devices (for Disabled); Communication Aids (for Disabled); Computer Oriented Programs; *Computer Software; *Computer System Design; *Disabilities; Educational Technology; Information Technology; *Input Output Devices; Keyboarding (Data Entry); *Microcomputers; Needs Assessment |

ABSTRACT

A microcomputer can be used in many different ways to assist people with disabilities. A computer's usefulness for a given individual is determined by the computer applications that are needed and by the specific problems the disability presents. In general, there are currently three ways that people with disabilities can use a microcomputer: (1) Many special software programs that run on standard computers have been written or adapted specifically for use by individuals with physical disabilities. They include communication and writing programs, word processing programs, motor training games, educational software, and therapy and assessment programs. (2) The operating system of a computer can be modified to accommodate special adaptations in the input or output process and to increase the rate of input. Standard software can then be used. (3) Hardware modifications can also enable disabled individuals to use standard software. These adaptations consist of simple modifications to the keyboard, disk drives, or computer screens, and connection of special alternate keyboards, disk drives, or alternate displays. A list of information sources on hardware and software developments concludes the paper. (JDD)

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ED297501

# COMMONLY ASKED QUESTIONS - COMPUTERS

**Revised 1987**

## Q: I KNOW SOMEONE WHO HAS A DISABILITY. HOW CAN A COMPUTER BE USEFUL TO THEM?

First, it is important to know what it is that you would like the computer to do. A microcomputer can be used in many different ways to assist people with disabilities. It can be used to help meet communication needs such as conversation and writing; it can be used to assist in education, recreation, independent living, and mobility. In some cases, it is used to provide new techniques for education or recreation. In other applications, computers can provide a disabled individual with a different way of accomplishing tasks non-disabled individuals normally accomplish without a computer. For example, for many people with disabilities, the lack of an effective mechanism for writing or conversing presents a serious barrier to meaningful opportunities for education, employment, personal development, or creativity.

Finally, individuals with disabilities need to operate computers for the same reasons that anyone else might need to use computers: to make use of the standard software programs that they find in their schools, homes, and business. This last need is an important one. People with disabilities need to be able to use computers not just with special programs written for them, but also with all of the standard software programs written for non-disabled individuals, such as:

- word processing programs
- spreadsheet programs
- art and design programs
- educational programs
- database management programs, and more.

The type of disability and the specific problems the disability presents are also important in discussing what is available. People with physical disabilities, for example, primarily have difficulty with the input to, and control of, computers and software. They may also have difficulty handling disks and other materials that they use with the computer. People with sensory disabilities, especially the visually impaired, experience difficulty in getting information from the computer. Most of the output from a computer today is through the monitor screen. For individuals who have difficulty in seeing the screen, or who are completely unable to see the screen, alternate display methods may be required. People who have language disorders (such as aphasia) or who have learning disabilities may be able to benefit from alternate input and output devices, but primarily need assistance in message formulation, perception, and other areas, which are still in great need of research.

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In general, there are currently three ways that people with disabilities can use a microcomputer:

1) Using SPECIAL software designed to run on standard computers;

2) Modifying the operating system software in the computer to allow disabled individuals to use STANDARD software;

3) The use of hardware adaptations or devices to allow disabled individuals to use STANDARD software.

## 1) Using SPECIAL Software Designed to Run On Standard Computers

There is a wide range of custom software written or adapted specifically for use by individuals with physical disabilities. Some of these programs require as little as one switch to operate them. These programs include: communication and writing programs, word processing programs, motor training games, educational software, and therapy and assessment programs.

For blind and visually impaired individuals, there are programs that provide text-to-braille and braille-to-text translation; talking software for word processing; talking software for database management; programs for enlarged print and enlarged graphics; information managers such as talking phone directories, address lists, and calendars; and automatic form writers to permit completion of standard forms.

These programs run on the standard computer but are specially designed to serve particular needs relating to disabilities. (Some of them also require some special equipment such as a switch, a speech synthesizer, a braille printer, etc.) Software in this category, however, does not provide access to the software available in the general marketplace–software *not* designed specifically for people with disabilities. There are problems with having *only* this specialized kind of access:

- If disabled employees do not use the same software as their co-workers, it is much more difficult for them to share files and data.

- If disabled students must use separate software, it is more difficult for them to be mainstreamed into classroom computer activities.

- Since the market for special disability-related software is smaller the the rest of the market, companies cannot spend as much money on development or offer as many titles.

One solution would be to make all software accessible to people with any disability, but this option is impractical. A much more viable solution is to adapt the computers themselves so that a disabled person can use any software. This type of solution is commonly known as "transparent access." Some of these adaptations are simple and can be incorporated into the design of all computers. Most, however, are more complex, and are added to the computer system as options. The transparent access products that have been developed fall into two categories: software modifications and hardware modifications.

## 2) Modification of the Operating System Software in the Computer to Allow Disabled Individuals to Use STANDARD Software

The software approach to transparent access involves changing the *operating system* of the computer. The operating system is a special software program that "tells" the various components of the computer system how to interact with each other. The operating system is loaded into the computer's memory when the computer is first turned on, and remains in the computer, running "in the background," while another software program (such as a word processor) is being used.

Because the operating system coordinates the computer's input and output, it can be modified to accommodate special adaptations. A physically disabled computer user, for instance, might not be able to type on the keyboard, but might be able to make Morse code signals by hitting a switch. A special adaptation can be made in the operating system so that particular Morse codes will be equivalent to particular keys on the keyboard. When the person makes three "dashes" on the switch, the operating system will then recognize this as a letter "S." The letter will then appear in the user's word processing program (or any other software program), just as if it had been typed on the keyboard.

Changes can also be made in the operating system instructions so that the output sent to the screen will also be sent to a speech synthesizer or braille display. Upper and lower case letters, punctuation, special characters, and the state of various key (like "CAPS LOCK") can all be identified by the visually impaired user. Any line can be read or spelled out. The user controls which portion of the screen to read using special commands typed on the keyboard.

For people whose disability makes it difficult to type quickly enough, there are adaptations to increase the rate of input. Specialized abbreviation expansion routines, word prediction routines, and other techniques allow whole words, phrases, and sentences to be communicated using a small number of keystrokes.

Unfortunately, there are many pieces of software on the market that do not use the computer's operating system to access the keyboard or computer screen. Software that "cheats" the operating system generally is designed that way in order to speed up the software, or add special features. As a result, the software approach to transparent access provides only a partial solution, and will work only with a certain portion of the software for any given computer. At the present time, no operating system modifications have been identified that will work 100% of the time. There are some, however, which work for *most* software programs. It is anticipated that future operating systems will make this approach more and more workable.

## 3) The Use of Hardware Adaptations or Devices to Allow Disabled Individuals to Use STANDARD Software

At the present time, about the only way to guarantee that a disabled individual will be able to use *all* standard software for a computer is to use a hardware modification of some type. These modifications can be implemented in such a way that the computer cannot tell that the disabled person is not using the computer in a standard, unmodified way. Because the computer cannot tell that these modifications are in place, they are termed "fully transparent" modifications. A fully transparent modification will allow a disabled individual access to *all standard software.* Furthermore it will not interfere at all with the operation of the computer or the software.

There are two major types of hardware modifications: a) simple modifications to the keyboard, disk drives, or computer screen, and b) connection of special alternate keyboards, disk drives, or alternate displays.

*A) Simple Modifications to the Keyboard to Facilitate Their Use by Disabled Individuals*

The most common modification for physically disabled persons involves the use of *keyguards* and *key latches.* Keyguards are plates that fit over the standard keyboard, and have holes over each key. The disabled person can lean on the keyguard to stabilize his hand motions and then poke a finger (or stylus, mouthstick, headstick, etc.) down through the holes to operate the keys. This helps prevent incorrect keys from being pressed.

Key latches are used to allow the disabled individual who is using a single finger (or stylus, headstick, etc.) to handle keys such as SHIFT and CONTROL, which must be pressed at the same time as another key. Key latch mechanisms fit over a key such as SHIFT and hold that key down while other keys are typed. Most keyguards have latches built into them, and keylatches are commonly available without keyguards as well. There are also software key latching programs which work with most standard software (these are like the "software modifications" described in #2 above).

Adaptations have also been developed for disk drives. *Disk loading trays* attach to the front of the disk drive and provide the user with a place to rest the disk when sliding it into the slot in the drive. Adaptations for handling disks and paper are also available, or can be custom developed. There are simple adaptations to make the computer screen more accessible to visually impaired users, including enlarging lenses that can be installed in front of the screen.

*B) Connection of Special Alternate Keyboards, Disk Drives, or Displays*

For individuals unable to use the standard keyboard, specialized *alternate input devices* have been developed. Optical lightbeam pointers can be used to select items displayed on a communication aid, or to select from a "keyboard" displayed on the computer screen. Keyboards have also been developed which allow the individual to "type" by looking at "keys" on an eye gaze keyboard. (This system requires a user with eye movement but a fairly stable head position). Large *expanded keyboards* are available for those who lack fine motor control, and *miniature keyboards* are available for those who have limited range of motion. Approaches are also available that allow individuals using a single switch or joystick to operate the computer. Another promising new field for physically disabled individuals is *voice input speech recognition* devices. Voice input interfaces are available, although their use and vocabulary size is currently limited.

All of these alternate techniques use a principle called *keyboard emulation* to allow the disabled individual to use any standard software on the computer. A keyboard emulator is simply a device that creates exactly the same signals as the standard keyboard. To the computer, the input from keyboard emulator looks identical to that from a standard keyboard, and therefore any software that will run with the standard keyboard will run with the keyboard emulator. Keyboard emulators are also designed so that the standard computer keyboard remains connected while the emulator is in use, allowing disabled and non-disabled workers to share the computer.

The keyboard emulation function is sometimes built directly into the specialized input device; in this case, the special or alternate keyboard can be connected directly to the

computer. In other cases, a special adapter (a *keyboard emulating interface*) must be connected between the computer and the special input device. In some cases this interface is a hardware unit; in other cases the same function can be performed by a software program running on the computer. Keyboard emulating interfaces can allow a person who uses a communication aid (a special portable computer used for communication by non-speaking people) to use their communication aid in place of the standard computer keyboard.

People who are blind or have visual impairments need an *alternate output*: some way of getting information from the computer besides looking at the standard computer screen. Devices that provide enlarged images, voice output, and braille output are available. People with low vision can sometimes use an over-sized computer screen to increase readability. More advanced electronic adaptations exist, including systems that provide electronically expanded images of a portion of the computer screen. The characters can be enlarged, in stages, up to a point where only one or two letters will fit on the entire screen.

For totally blind individuals, systems are available that tap into the computer's memory where the screen's contents are stored. This information can then be fed out to braille displays or to speech synthesizers to allow blind individuals to "read" the computer screen. *Dynamic braille displays* have small pins that are raised and lowered electronically to form different braille characters. *Screen reading programs* send the contents of the screen to a *speech synthesizer*, which decides how the text should be pronounced and speaks it in an artificial voice. There are also devices that allow an individual to scan the CRT screen with a tiny hand-held camera, and have a raised tactile representation of part of the screen appear on one of their fingertips.

## SUMMARY

As you can see, a wide range of SPECIAL SOFTWARE has been developed for disabled individuals, as well as special adaptations and devices to allow access STANDARD SOFTWARE. There is a very definite limit, however, to what computers can do today based upon the programs and adaptations available for them. In trying to determine whether a computer will help a given individual, it is important to first know exactly what it is that you would like the individual to be able to do with the computer. You can then see whether a computer program or adaptation is available that will enable the person to accomplish that goal. Detailed summaries on different aspects of existing hardware and software developments for disabled individuals are available from a number of sources. A good place to start is *The Rehab/Education ResourceBook Series: Communication, Control and Computer Access for Disabled and Elderly Individuals*, available from the Trace Center (see below). Complete information on all of the developments discussed above, as well as on many other adaptations (over 1,000 in all), can be found in these publications.

A wide variety of newsletters, organizations, etc. with valuable information about computer access are listed on Trace Center "Quick Sheets." (Contact the Center about ordering.) Some of the other information sources in this field include:

Reprint Service (ask for an Information Available Brochure)
Trace Research & Development Center
S-151 Waisman Center
1500 Highland Avenue
Madison, WI 53705

Closing the Gap
(a newspaper on computer use by disabled persons)
Budd Hagen, Ed.
P. O. Box 68
Henderson, MN 56044

Link and Go
(includes COPH Bulletin)
Congress on the Physically Handicapped
2030 Irving Park Road
Chicago, IL 60618

Raised Dot Computing Newsletter
Raised Dot Computing
408 South Baldwin Street
Madison, WI 53703

Communication Outlook
International Society for Augmentative
and Alternative Communication
P.O. Box 1762, Station R
Toronto, Ontario M4G 4A3
CANADA

Included with this letter may be resource lists that pertain to your specific question. Once you have had a chance to read over this material and contact some of the other suggested resources for more detailed information, please feel free to write or phone us with further questions.